Electrical Concerns in the Design of Energy Efficient Research Labs

NIH BUILDING 50

- **Power Design Levels and System configuration**
  - Establish connected load power requirement building wide
  - Use diversity factor for estimated real power consumption load
  - Provide adequate, reliable, uniform and cost effective power
- **Lighting -**
  - Establish Light Levels, Fixture Types and Controls
  - Stress efficient fixtures and controls
- **Emergency Power and /or Uninterruptable Power Supply (UPS)**
  - Clearly differentiate between Emergency and Uninterruptable Power, determine true needs, extent and location of service.
- **Provide room for future growth in all electrical services**
  - Provide determined percentage of unused breakers and blank knock-outs in all normal and emergency power panels

Electrical System Basis of Design

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- 3 - 13.8 KV 3 conductor 500 MCM PILC primary feeders supply power
- 3 Transformer Network System, 2500 KVA each, 1 redundant
- Building gross design load was 20 VA /Sq Ft for a total of 5000 KVA
- Network Protectors are 4500 AMPS 480 / 277
- Secondary Switchgear 4000 AMPS 480 /277
- Vertical Distribution is 2 vertical 1600 Amp cable bus in shafts
- Floor Distribution is 2 each, 112.5 and 225 KVA dry transformers with 208/120 distribution panels, 225 amp branch circuits; with 42 circuits per each 2 lab modules panel
- Each lab bench is fed by 1 60 amp circuit with single pole 20 amp circuit breakers in a wiremold raceway

Main Transformer

Switchgear

Cable Bus

Transformer in Interstitial

Electrical System Basis of Design (Cont)

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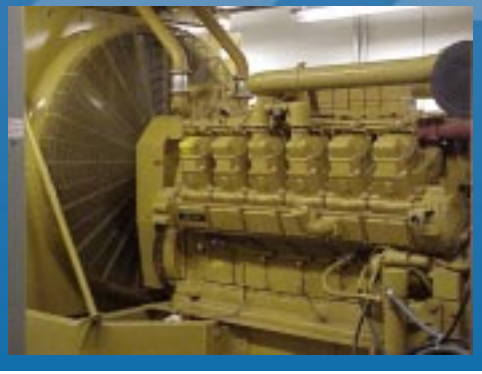
- Emergency Power system is sized at 6.8 W /Sq Ft or 1800 KW provided by an exterior modular skid mounted 1500 Horsepower weatherproof soundproof diesel generator, with a fuel tank to provide 48 hour run time
- A 1600 KW air cooled load bank will be provided
- 4 automatic transfer switches are provided to serve life safety, lab emergency equipment, emergency mechanical equipment and fire pump
- Lighting is primarily T-8 fluorescent lamps with electronic ballasts
- A programmable lighting control is provided, as are motion detectors
- A Local area Network LAN is provided throughout the building on cable tray in the interstitial level. Telephone and Lan rooms are located on each interstitial level.
- A proximity card reader system will provide access control throughout the building. Each neighborhood will have a secured perimeter

Cable tray

NIH Building 50 Energy Conservation Features

Electrical Systems

- **Power** - gross design load was 20 VA /Sq Ft for a total of 5000 KVA
- **Lighting**
  - High efficiency T-8 lamps with electronic ballasts
  - LED exit signs
  - Architecture provides large windows for daylighting;
    Electrical provides photocells to control main lighting
  - Use of task lighting at personal work stations;
  - Programmable lighting control system turns all lights off at night
  - Motion detectors in enclosed rooms to turn lights off when unoccupied
- **Emergency power** provided at 6.8 W /Sq Ft or 1800 KW
- **UPS power** optional provided by user locally or installed in the interstitial at extra cost to user



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Utility Consumption Rates

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Metering - All Utilities are metered so the building's energy usage can be tracked and benchmarked - a first at NIH

With energy recovery wheels

chilled water: 2150 tons

steam: 48,250 lb/hr

Without energy recovery wheels

chilled water 3605 tons

steam: 85,000 lb/hr

Note that the energy recovery wheels result in estimated savings of 40% in chilled water and steam

(steam is used for process equipment such as autoclaves, as well as heating, & humidification)

Utility Consumption Rates & Rebate

- **Electrical Power** -
  - Design Load was 17 W / Sq Ft (5000 KVA)
  - Power Consumption is estimated at 10 to 12 W / Sq Ft (or 3000 to 3500 KVA)
- **Emergency Generator** is designed at 6.8 W / Sq Ft - 1800 KW
- **Natural Gas** - 940 Cubic Feet / Hour
- **Water** - 540 gallons / Minute

Building 50 Rebate - due in a large part to the Energy Recovery Wheels, the local energy provider, **PEPCO, will be issuing a rebate to the Government calculated at $2 million** because of the energy savings that will result from the various energy efficient devices in the design of the facility.

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HHS Energy Award

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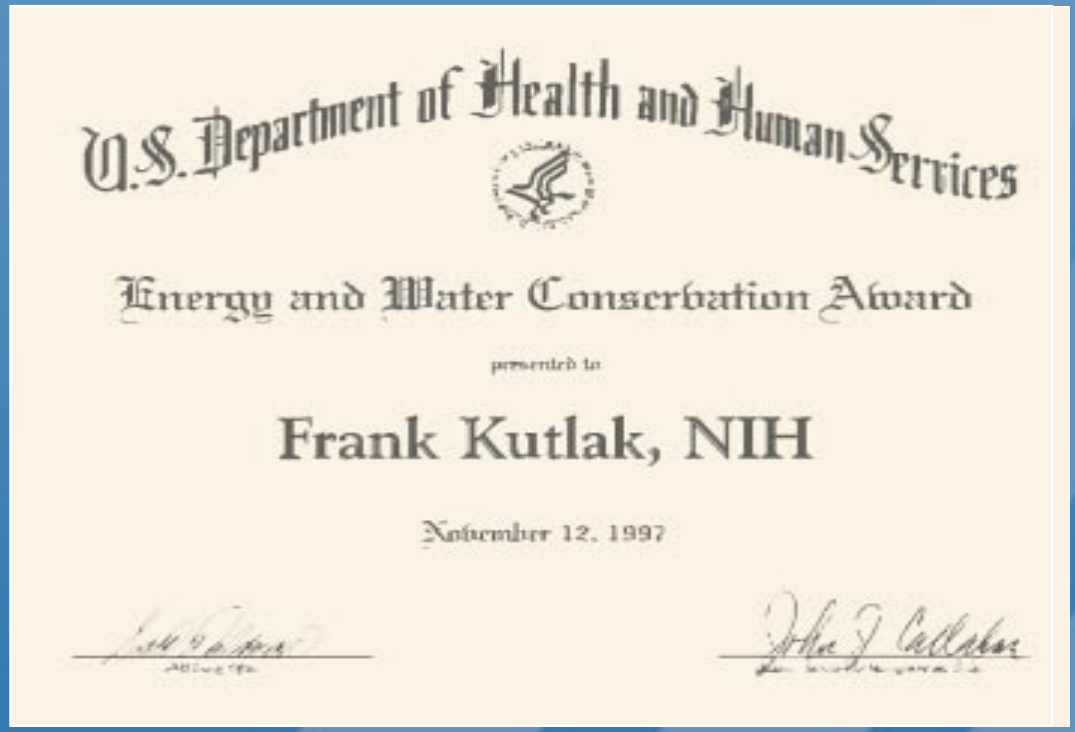

U.S. Department of Health and Human Services

Energy and Water Conservation Award

presented to

Frank Kutlak, NIH

November 12, 1997

The Louis Stokes Laboratories / Building 50 was awarded the 1997 Dept of Health and Human Services National "Energy and Water Conservation Award' for it's efficient energy design

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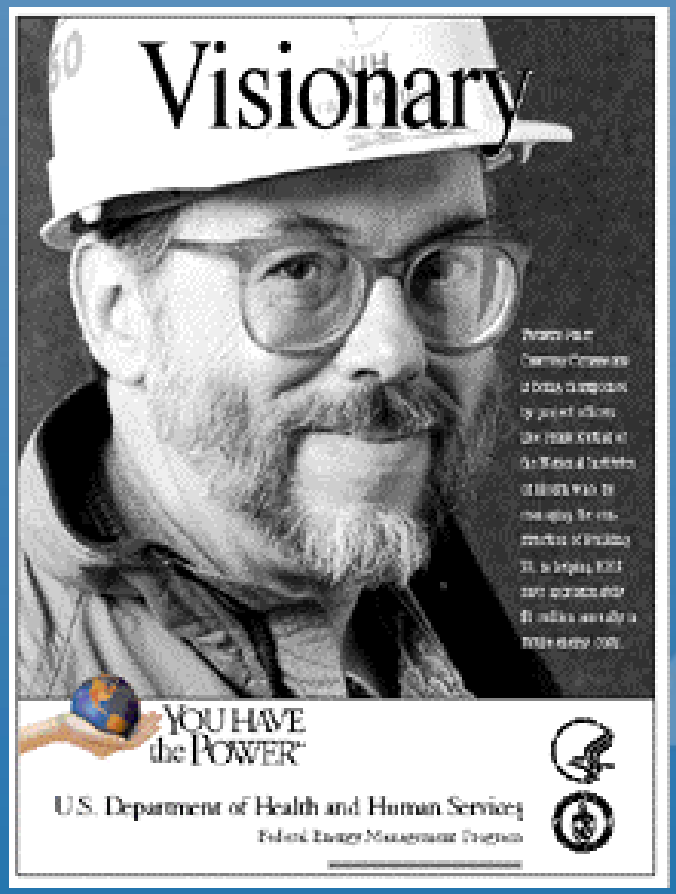
DOE / FEMP - Federal Energy Management Program
"You Have the Power" Campaign



1998 Energy Champion

Frank Kutlak - Architect / Project Officer
Department of Health and Human Services

Twenty- First Century Citizenship
is being championed by Project Officers
like Frank Kutlak of the
Office of Research Services at the
National Institutes of Health
who, by managing the construction of
Building 50, is helping HHS save
approximately 40% in future energy costs.

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Effective Project Management Decisions

NIH BUILDING 50

Schedule

- Fast track design and construction in 2 phases
- Phase 1 - site, utility relocations, excavation and foundations
- Phase 2 - structure, enclosure, electrical, mechanical, plumbing, vertical circulation systems, interiors, lab casework, finishes
- Phase 1 construction proceeded while the Phase 2 Construction Documents were being completed.

Procurement

- A local A / E team with demonstrated lab experience was selected
- A fee- for- service Construction Management Firm was secured utilizing an existing GSA task order contract.
- The Construction Contractors for both Phases were selected using a “Best Value” procurement process, not a sealed low bid.

Value Engineering and Partnering

- The C.M. provided facilitated value engineering sessions during the design phase; as well as formalized partnering for both construction phases. They also provided constructability reviews and estimates during the design stage

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Effective Design Decisions / Features

NIH BUILDING 50

- Extremely functional and highly efficient open lab planning concept
  - floor plans are 60% efficient (net to gross ratio)
  - all occupants have work stations desks at exterior windows
  - appropriate, durable materials and finishes
- Cost effective interstitial mechanical distribution system
  - more easily constructed and maintained
  - floor to floor heights very low for interstitial concept
- Post tension concrete structural system concept
  - required 40% less concrete and reinforcing steel
- Modular, flexible laboratory casework concept
- Practical, feasible and effective energy conservation elements
  - Systems resulted in $2 million rebate to Government
  - Annual energy use will be a t least 40% less than traditional research labs
- Minimized redundant backup facilities in vivarium
  - Elevator and air handlers backed up by building systems
- Vivarium interiors are gyp board on studs not traditional masonry block

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NIH BUILDING 50

Original Design

- 5 stories plus basement and mechanical penthouse
256,000 GSF

Design as modified Dec 1998

- *6 stories* plus basement and mechanical penthouse
290,000 GSF
- A floor was added during the construction phase which provided an additional 44 lab modules
- It was added within the original budget and added only 2 months to the overall project duration

Why the additional floor was possible

- *If the project had kept going at it's initial rate it would have resulted in a surplus of several million dollars at completion.*
- *There were several contributing reasons for this surplus*
  - The project program was clearly stated and maintained
    - There was no scope increase during the design phase
  - The project had a prudent budget with appropriate contingency
  - The project has a very effective design and management team
    - All NIH / ORS reviews and decisions were timely and direct
    - The HLM design consultants bid documents were very good
    - The CRSS Construction Management has been very effective
  - Good design, procurement and Construction process decisions were made
    - The plan was very functional and highly efficient
    - Value Engineering was applied throughout the design phase
    - A fast track schedule was used and all design and procurement milestone dates were met
    - The "Best Value " procurement was used to procure the contractor
    - A formal facilitated partnering program was applied
    - The first phase finished on schedule with no claims
    - The energy conservation designs resulted in a large rebate
    - To date the change orders have been very low
  - The project benefited from good competitive market conditions
  - It also benefited from a low inflation rate over several years
  - BELL, The Phase 2 Contractor is very proactive and fair and reasonable

Project Credits

Owner / owner's Representative
National Institutes of Health
Office of Research Services
Division of Engineering Services
Design, Construction & Alterations Branch

Architect - HLM Design Inc, Bethesda MD

Engineers - RMF Engineering, Baltimore MD

Construction Manager- CRSS Constructors Arlington VA

Commissioning Agent - Facility Dynamics,
Columbia MD

Testing and Balancing Consultant - Weisman Inc
Towson MD

Project Credits (Cont)

NIH BUILDING 50

General Contractor and Mechanical Contractor
The BELL Company, Kensington MD

HVAC Sub Contractor - Stromberg Metals, Beltsville MD

Electrical Sub Contractor - Young Electric, Olney MD

Air Handlers - Energy Labs, San Diego CA

Energy Wheels - Semco

Fume Hoods - ISEC, Fisher Hamilton

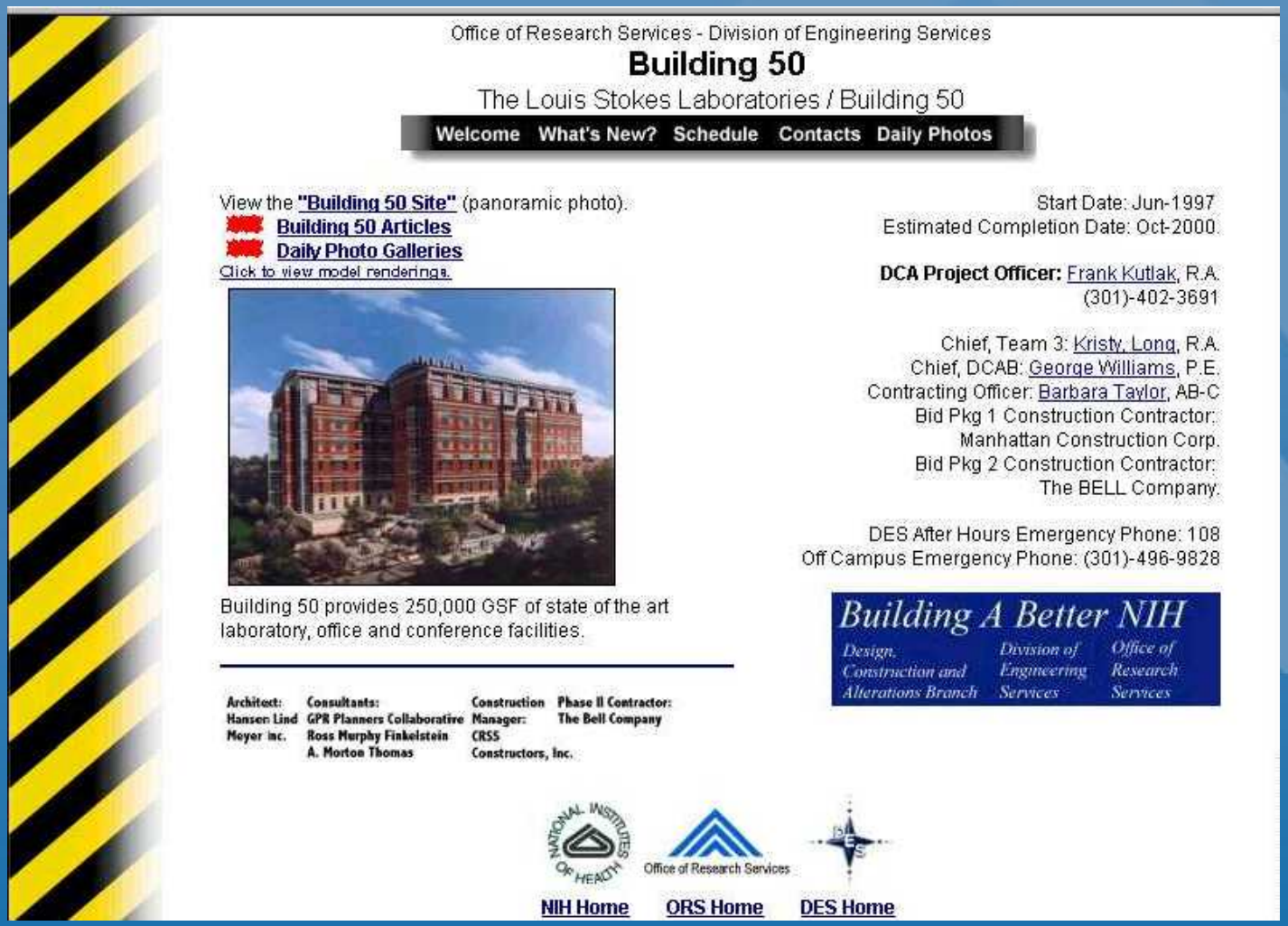
Controls - Siemens

Siemens Building Technologies, Inc.
Landis Division

Louis Stokes Laboratories / Building 50 Website Address

http://des.od.nih.gov/building_50

Features of the Building 50 design including floor plans, renderings, model photos, daily construction photos, hyper links to building 50 "NIH Record" articles, technical articles and a real time view of the construction site can be viewed on the Building 50 website



Office of Research Services

Other Research Laboratory Design Websites

NIH BUILDING 50

NIH Office of Research Services

Office of Research Services
Serving the NIH Community
ORS

Main webpage - http://www.nih.gov/od/ors for all ORS services

Choose "NIH Design Policy and Guidelines" for design guidelines for Clinical Center, Research Laboratory, or Vivarium Volumes

CLINICAL CENTER
NIH DESIGN POLICY AND GUIDELINES

RESEARCH LABORATORY
NIH DESIGN POLICY AND GUIDELINES

VIVARIUM
NIH DESIGN POLICY AND GUIDELINES

Lawrence Berkeley National Laboratory

"A Design Guide for Energy Efficient Research Laboratories"

http://ateam.lbl.gov/design-guide

EPA - Labs of the 21st Century

http://www.epa.gov/labs21century

for the Building 50 Case Study choose "abstracts", then "Frank Kutlak"

EPA United States Environmental Protection Agency
LABS FOR THE 21ST CENTURY

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Phase 1 - Utility relocations and Excavation

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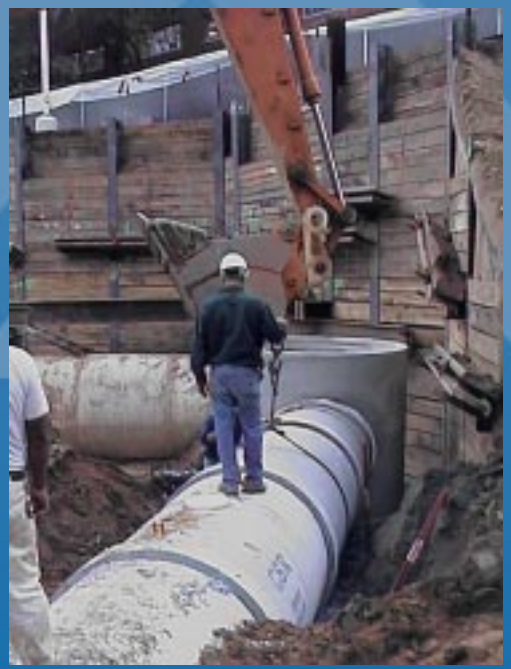
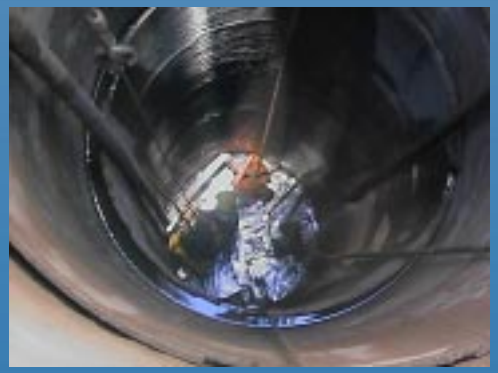


Phase 1 - Caisson Foundations







Phase 2 photos

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Phase 2 photos

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Phase 2 photos

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Current Elevations

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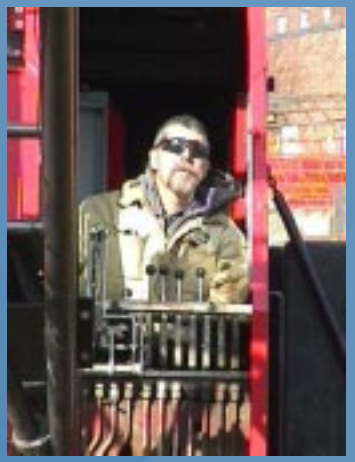
People

People



People

Congressman Louis Stokes visited the project Sept 1st

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Institutes in The Louis Stokes Laboratories Building 50

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National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health

National Institute on Deafness and Other Communication Disorders

N I D C D

The National Heart, Lung, and Blood Institute

NIAID

National Institute of Allergy and Infectious Diseases
National Institutes of Health

NATIONAL CANCER INSTITUTE®

NATIONAL INSTITUTE OF ARTHRITIS AND MUSCULOSKELETAL AND SKIN DISEASES

NIAMS

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